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COMMITTEE OF EXPERTS ON THE
TRANSPORT OF DANGEROUS GOODS

Sub-Committee of Experts on the
Transport of Dangerous Goods
(Fifteenth session,
Geneva, 29 June-10 July 1998,
agenda item 5 (a))

MISCELLANEOUS DRAFT AMENDMENTS TO THE MODEL REGULATIONS ON THE TRANSPORT OF DANGEROUS GOODS

Comments and Proposals on the Document ST/SG/AC.10/C.3/1997/83 dated 29 September 1997

Listing and classification
Lithium batteries

Transmitted by the Expert from Germany

I. Comments

I.1 Tests T.1 - T.6

The proposal submitted by the expert of the United States is based on the existing recommendations of the UN for lithium batteries. According to this proposal, large lithium-ion and lithium-polymer batteries, e.g. developed for automotive applications, are classified in class 9, provided that the tests T.1 to T.6 given under chapter 38.3 of the existing recommendations are passed. These transport tests were established for small, mostly cylindrical, consumer cells with lithium-metal electrode. Their application to large, cylindrical or prismatic lithium-ion and lithium-polymer batteries is not straightforward. Therefore, the expert from Germany hereby assesses the test procedures T.1 to T.6 with respect to the following aspects:

A) Scenario: Is the scenario relevant for the transport of large cells / batteries ?
B) Feasibility: Are the tests feasible on large cells / batteries ?
C) Specification: Is the specification complete with respect to large cells / batteries ?

T.1. Altitude simulation, extreme temperature and short circuit

	Scenario	Feasibility	Specification
altitude simulation	o.k.	o.k.	o.k.
extreme temperature	48h @ 75°C is not realistic	large battery has to be brought out of oven into freezer, e.g. with fork lift	transient time from highest T to lowest T not sufficient
short circuit	50 mΩ may not be a short circuit for large cells	large heat capacity results in long cooling-off times	the temperature of the test area also needs to be defined

T.2. Vibration, shock and short circuit

	Scenario	Feasibility	Specification
vibration	o.k.	o.k.	o.k.
shock	125 to 175g peak is not realistic	large mass results in large forces, may not be feasible	o.k.
short circuit	see T.1	see T.1	see T.1

Note: The 'shock' test requires significantly larger g loads than the application of the large batteries in the automotive field (shock tests simulating road car accidents typically range up to 40g peak).

T.3 Vibration, shock and charge

	Scenario	Feasibility	Specification
vibration	see T.2	see T.2	see T.2
shock	see T.2	see T.2	see T.2
charge	battery assembly with reversed cell is not realistic	current should be limited to maximum charge current	o.k.

Note: The large batteries are integrated assemblies from which individual cells cannot be easily removed. Reversed cells would be detected either in qualitity control at production or by the battery management system during test operation. Therefore, the test may not be relevant for the transport of large cells or batteries.

T.4. Internal short circuit

	Scenario	Feasibility	Specification
internal short circuit	6 mm rod is not adapted to larger cell sizes	crushing until voltage drops may require unrealistic forces on large cells	a) large prismatic cells should be tested in two axes b) max. force or max. deformation should be given

T.5. Vibration, shock and low capacity cell

	Scenario	Feasibility	Specification
vibration	see T.2	see T.2	see T.2
shock	see T.2	see T.2	see T.2
low capacity cell	o.k.	o.k.	o.k.

Note: The 'low capacity cell'-test, which is done with a cell having performed 50 deep cycles, results in a minor overdischarge, because cells of the technologies under discussion usually retain about 90% of the initial capacity after 50 cycles. Since 'vibration' and 'shock' are tested on batteries in sequence T.2 and forced discharge on cells in sequence T.6, the test sequence T.5 can be omitted.

T.6. Forced discharge

	Scenario	Feasibility	Specification
forced discharge	o.k.	o.k.	o.k.

General Remark: Large batteries of modern technologies may be equipped with liquid- or air-cooling systems. For evaluation of transport safety, it is reasonable to assume that the cooling system does not operate during transport and therefore, the series T tests should be performed without activating these cooling systems. As these batteries may also be equipped with computerized battery management systems performing active safety functions in the battery application, the series T tests should be performed without acitvating these battery management systems.

I.2 New Special Provision 28A to UN 3090

Page 6 of draft amendments, under proposals 11.(c): With respect to safety, it is sufficient to require cells to be new and discharged, they do not need to by uncycled. In fact, cells or batteries of the technologies under discussion usually undergo some formation cycles after assembly.

II. Proposals

II.1 Tests T.1 - T.6

T.1. Altitude simulation, extreme temperature and short circuit

	Changes
altitude simulation	----------
extreme temperature	48h @ **60°C / 10 minutes transient** / 6h @ -20°C
short circuit	1) **resistance < 30 % of cell or battery resistance** 2) cell / battery @ 55°C, **room between 15°C and 25°C**

T.2. Vibration, shock and short circuit

	Changes
vibration	----------
shock	peak acceleration = **50 g**, first 3 ms = **20g** min.
short circuit	see T.1

T.3 Vibration, shock and charge

	Changes
vibration	----------
shock	see T.2
charge	**series resistance** adjusted such that the average current draw equals the **maximum continuous charge current** given by manufacturer

T.4. Internal short circuit

	Changes
internal short circuit	1) diameter of rod = **50% of smallest cell dimension** 2) test **all axes perpendicular to terminal face** (cylindrical: radial axis only, prismatic: two axes) 3) **maximum force = 10 kN** (equals 1 metric ton)

T.5. Vibration, shock and low capacity cell

	Changes
vibration	**delete**
shock	**delete**
low capacity cell	**delete**

T.6. Forced discharge

	Changes
forced discharge	----------

General Change to Tests T.1 to T.6:
In the paragraph of all test descriptions headed: 'the number and condition of cells and batteries to be tested are', **add** a condition:
x) Cells and batteries are to be tested without active cooling or battery management systems being activated.

II.2 New Special Provision 28A to UN 3090

Page 6 of draft amendments, under proposals 11.(c): **Delete the word 'uncycled'** .